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NOTES ON VELIGERS OF JAPANESE OPISTHOBRANCHS (2)^{1,2)}

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With 9 Text-figures

In this second paper of the series are treated *Halgerda rubicunda* BABA of Dorididae and *Catriona ornata* (BABA) and *C. pinnifera* (BABA) of Cuthonidae. The first of the three was collected near the Seto Marine Biological Laboratory and an egg-mass was brought back to my home to rear veligers, while other two were collected at Tannowa facing Osaka Bay and observations were made at my home.

Halgerda rubicunda BABA

(Figs. 1-2)

A 40 mm long animal was collected from the under side of a stone in a tide-pool on Hatake-sima in Tanabe Bay near the Seto Marine Biological Laboratory

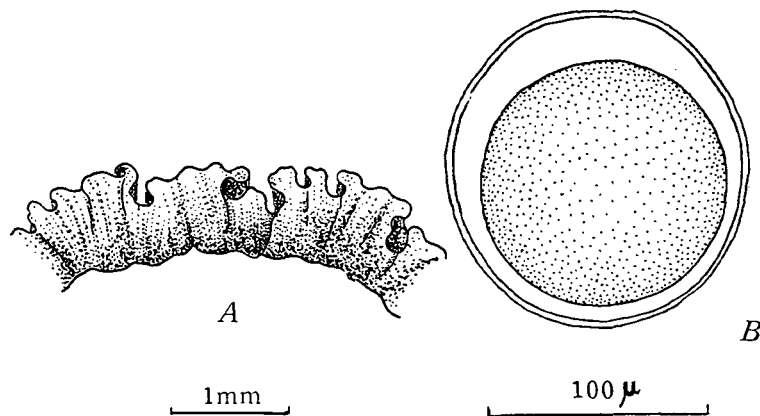


Fig. 1. *Halgerda rubicunda* BABA.

A. A part of egg-ribbon. B. Ovum in the capsule.

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2) A part of the studies supported by the financial aid granted from the Ministry of Education.

on July 23, 1960. When the animal was collected, it had just finished laying its egg-mass. Egg-mass is coiled sinistrally $3\frac{1}{4}$ times, measures 30×50 mm in outline of the coil and is coloured very beautifully scarlet. The ribbon (Fig. 1, A) is 7 mm wide and with its free border strongly waving. Egg-capsule is nearly spherical and about 130μ in diameter; the wall consists of two layers. Usually a single ovum, about 110μ in diameter (Fig. 1, B), occurs in each egg-capsule, rarely, however, some large egg-capsules may contain two ova which develop each into a normal veliger.

Early development: The egg-mass was brought in the laboratory and the

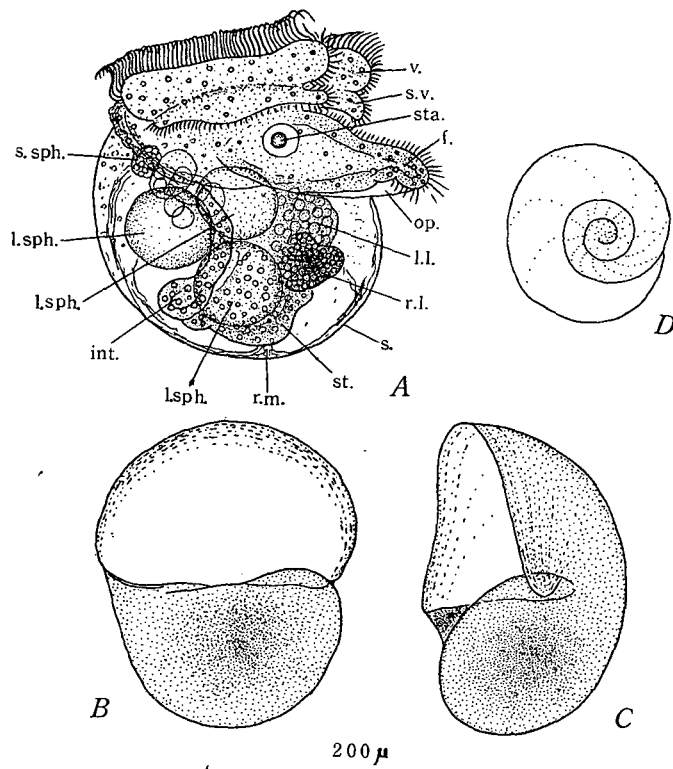


Fig. 2. *Halgerda rubicunda* BABA.

- A. Newly hatched veliger, from the right side.
- B. Larval shell, from the ventral side.
- C. The same, from the apex.
- D. Operculum.

Abbreviations: e...eye, f...foot, int...intestine, l.sph...large spherical body, l.k...larval kidney, l.l...left liver, m...mouth, oes...oesophagus, op...operculum, r.l...right liver, r.m...retractor muscle, s...shell, s.sph...small spherical body, st...stomach, s.w...swollen portion of the thickening along the inner part of the axis, sta...statocyst, s.v...subvelum, un.o...unknown organ possibly homologous to "yellow organ" of *C. ornata*, v...velum, y.o..."yellow organ".

further observations were made under the room temperatures of 27°–34°C. The slight sign of embryonic rotation was observed on the third day of the development. As the development proceeds, the deep scarlet colouration of egg-mass is gradually faded until it becomes quite faint. Hatching began on July 29, thus it took six days from the spawning to the hatching.

Veligers: The newly hatched veliger (Fig. 2, A) is reddish orange in colour. The shell (Fig. 2, B and C) is roundish and colourless, sinistral, with a long diameter of 200 to 230 μ , and has many sculptures consisting of very minute dots. The operculum (Fig. 2, D) is 120 \times 140 μ in size for instance, nearly circular and has a sculpture of a spiral line coiling about 3 $\frac{1}{3}$ times. The velum bears short cilia and contains refracting granules. The statocysts are distinct but no eyes. The ciliated foot does not contain any large cells, but some refracting granules in the tissue. The stomach and intestine have many refracting granules in the wall. The stomach is coloured light reddish orange. There are two liver-lobes as usual. The left liver is larger, slightly orange in colour, and includes sparsely rather large cells, while the right liver is smaller, dark reddish in colour and consists of closely packed small granules. There are three large spherical bodies (Fig. 2, A, l.sph.) on the right side of the body near the intestine, they are so prominent that they can not be over looked, although the nature of these bodies is quite unknown. One of them situated just near the anus, is transparent and quite colourless; while others are also transparent, but faintly grayish in colour. Besides, there is another smaller unknown organ (Fig. 2, A, s.sph.) just near the larval kidney, it is pale yellowish and encloses small granules.

Catriona ornata (BABA)

(Figs. 3–6)

BABA, HAMATANI and HISAI, 1956, p. 214, text-fig. 3A, pl. XXV, fig. 4.

From 7 to 15 mm long specimens of this species are found commonly at the low water region on the shore of Tannowa on the south-easter coast of Osaka Bay during the months from January to June. In this season egg-masses of this species can be seen on the under surface of stones with mother animals, especially frequently in March. Egg-masses (Fig. 3) are coiled sinistrally 2 to 4 times, 3 to 7 mm in diameter, and whitish in colour, though faintly tinted in yellow. The free border of this ribbon is never longer than the attachment border so that the ribbon surface is always even. Egg-capsules of the newly laid egg-mass are oval in shape and 140 to 180 μ in long diameter. Ova are round and with 90–110 μ diameter (Fig. 4).

Early development: An animal was spawning when it was collected on March 15, 1959. This egg-mass was kept under the room temperatures of 9°–21°C. The slight rotatory motion of embryos in capsules was seen first on the sixth day.

On the seventh day they attain the earliest stage of veliger; on visceral organs are differentiated yet, but their shape is very unique as seen in Fig. 5, A. At this time, egg-capsules are inflated and diameter reaches 230μ on an average. The hatching out of larvae took place in the fourteenth day and larvae entered the pelagic life.

Veligers: Newly hatched veligers (Fig. 5, C and D) are rather large, 300 to 330μ in length, and transparent and quite colourless. Shell (Fig. 6, A) is sinistral, clear and colourless and devoid of any sculptures. It is elongated ovoid and its long diameter is 234μ on an average (maximum 245μ and minimum 220μ), and short diameter is 146μ on an average (maximum 153μ and minimum 140μ). The initial whirl of the shell is rather large. There is a remarkable thickening along the inner part of the axis and it is swollen conspicuously near the under side as shown in Fig. 6, C, sw. The swollen portion is roughly spindle-shaped and with a slight constriction at the lower one-third. The operculum (Fig. 6, B) is semi-

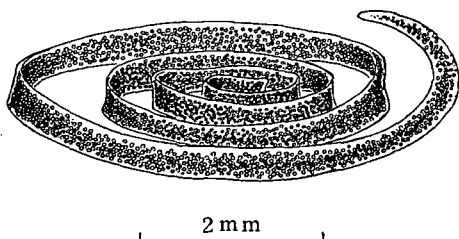


Fig. 3. *Catriona ornata* (BABA).
Newly laid egg-mass.

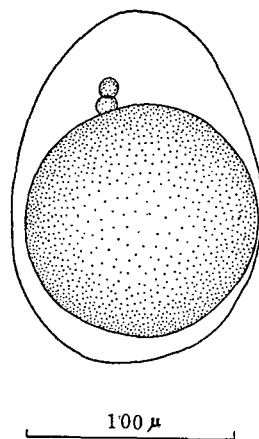
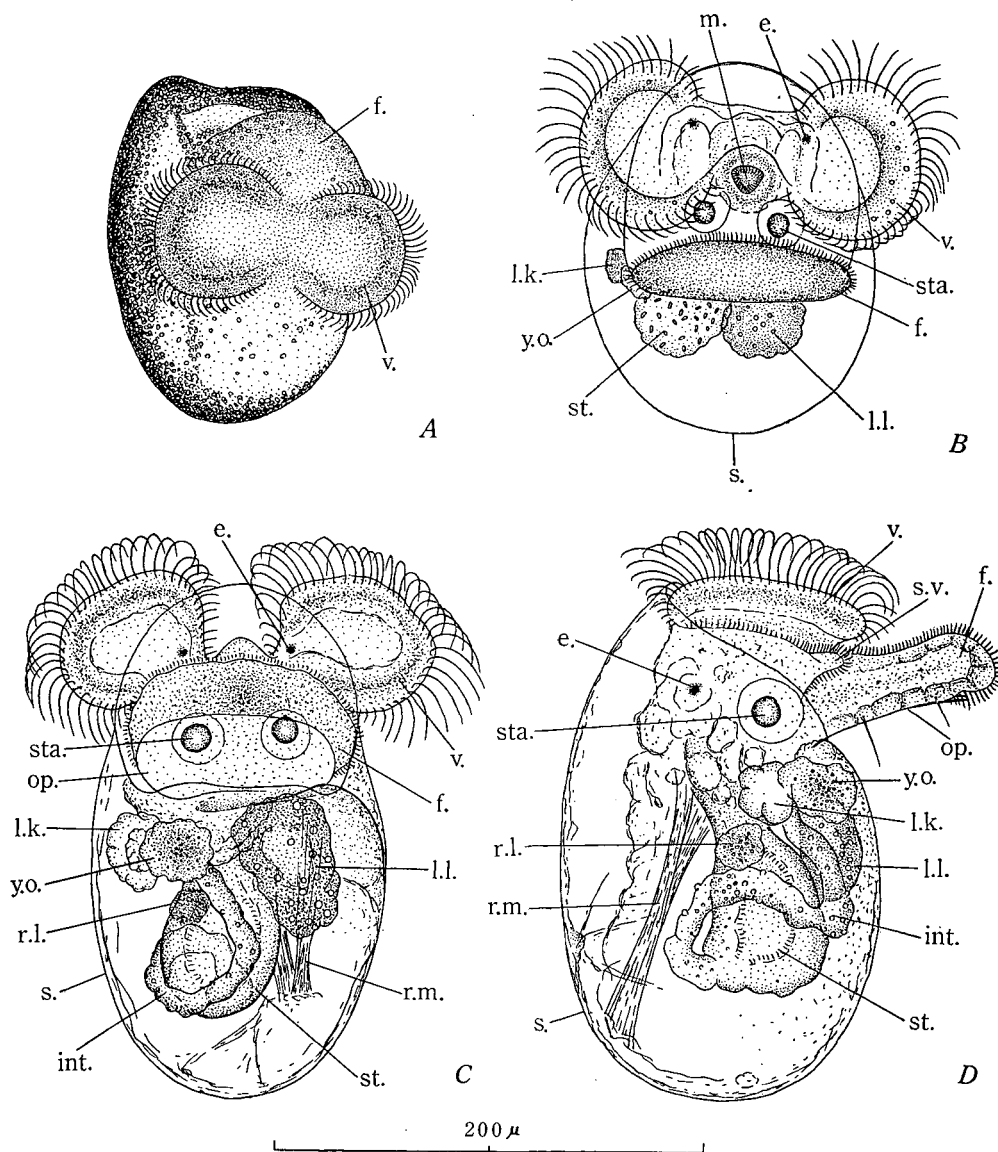


Fig. 4. *Catriona ornata* (BABA).
Ovum in the capsule.

circular, 100μ in long diameter, and has not any sculptures. The vela are rather small and attain 180μ in width when they are stretched; subvelum is well developed. Both velar organs are neither pigmented nor including refracting granules. The intermediate portion between right and left vela is not ciliated, this aspect differs distinctly from that of next *C. pinnifera*. The eyes are very distinct as they are pigmented in black; a pair of large statocysts are seen also. The foot has a dense cover of short cilia but no large cells in its tissue and protrudes beyond the operculum edge. It is provided with several long cilia which are probably of a sensory function. Mouth is rather small, round, ciliated and not pigmented; oesophagus is straight, with cilia on the inner wall and unpigmented, either. Stomach has many elliptical granules in its wall when the

Fig. 5. *Catriona ornata* (BABA).

- A. The earliest stage of veliger, from the right latero-ventral side.
 B. Veliger in the capsule, from the frontal side.
 C. Newly hatched veliger, from the ventral side.
 D. The same, from the right side.

(For other abbreviations see Fig. 2.)

veliger is still enclosed in the capsule (Fig. 5, B), but granules are missing in newly hatched veligers. There are two liver-lobes, they are colourless and contain small granules. The left lobe is larger and connected to the left-ventral side of the stomach, while the right one is smaller and connected to the right-dorsal side of the stomach. The slender intestine is issued from the rear dorsal edge of the stomach and runs along the stomach surface in a S-like course; it is furnished with warty cells on its surface. It reaches a round and unpigmented organ, probably larval kidney, at the right ventral side of the shell aperture. There is a small and faintly yellowish organ (Fig. 5, C and D, y.o.) containing many minute granules in its tissue, at the ventral side of the anus; the function of this "yellow organ" is, however, not clear.

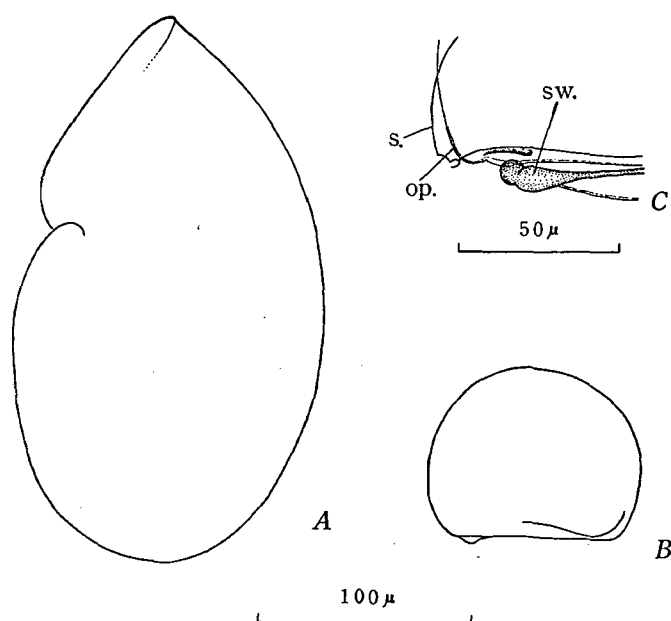


Fig. 6. *Catriona ornata* (BABA).

A. Larval shell, from the apex.

B. Operculum.

C. Lower portion of the thickening along the inner part of axis.
(op. margin of operculum, s. margin of shell aperture.)

(For other abbreviations see Fig. 2.)

Catriona pinnifera (BABA)

(Figs. 7-9)

From 5 to 15mm long animals are found on the under surface of stones just below the lowest tidal mark on the shore of Tannowa, during the season from

March to August. In this duration they lay their egg-masses (Fig. 7), which are in a form of small, soft and whitish ribbon, 2 to 7 mm in diameter and coiled sinistrally or dextrally 1 to 2 ½ times. The egg-capsule of the newly laid egg-mass is oval in outline and 160 to 180 μ in long diameter, the outline of capsule is shown by a in Fig. 6. A single ovum is contained in each capsule and it measures about 110 μ in the diameter (Fig. 8).

Early development: An egg-mass was laid in my laboratory on March 28, 1960 when the room temperature was 18°C and the further observations were made under 14°–25°C. On the sixth day of the development, embryos began the rotatory movement. On the next day they reached the earliest stage of the veliger (Fig. 9, A), which was just the same as that of the preceding *C. ornata*. The larvae were found escaping from the capsules on the fifteenth day and set out their free swimming plankton life. Also in this species, the inflation of egg-

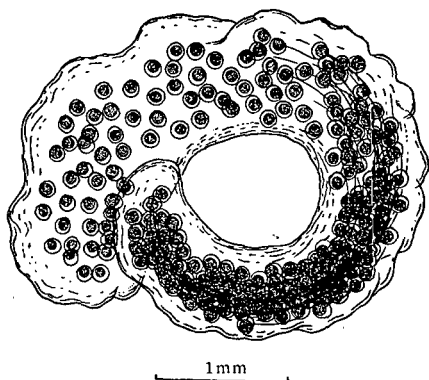


Fig. 7. *Catriona pinnifera* (BABA).
Newly laid egg-mass.

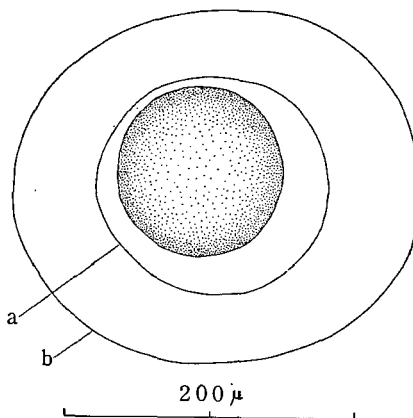


Fig. 8. *Catriona pinnifera* (BABA).
Newly laid egg in its capsule (a), (b) shows the outline of the capsule inflated after about 10 days.

capsules took place during the embryonal development, the outline of such swollen capsules is shown by b in Fig. 6.

Veligers: The newly hatched veligers of this species (Fig. 9, B) are nearly the same as those of preceding *C. ornata*. The whole body is transparent and quite colourless. The larval shell (Fig. 9, C) is sinistral, transparent and colourless, and devoid of any sculptures. Its long diameter measures 238 μ on an average (maximum 250 μ and minimum 220 μ) and short diameter is 144 μ on an average (maximum 150 μ and minimum 130 μ). The swollen portion of the thickening along the inner part of the axis is conspicuously bent near the middle and with two slight constrictions in the lower half. The operculum (Fig. 9, D) is semi-circular in outline, measures 90 μ in long diameter and has not any sculptures.

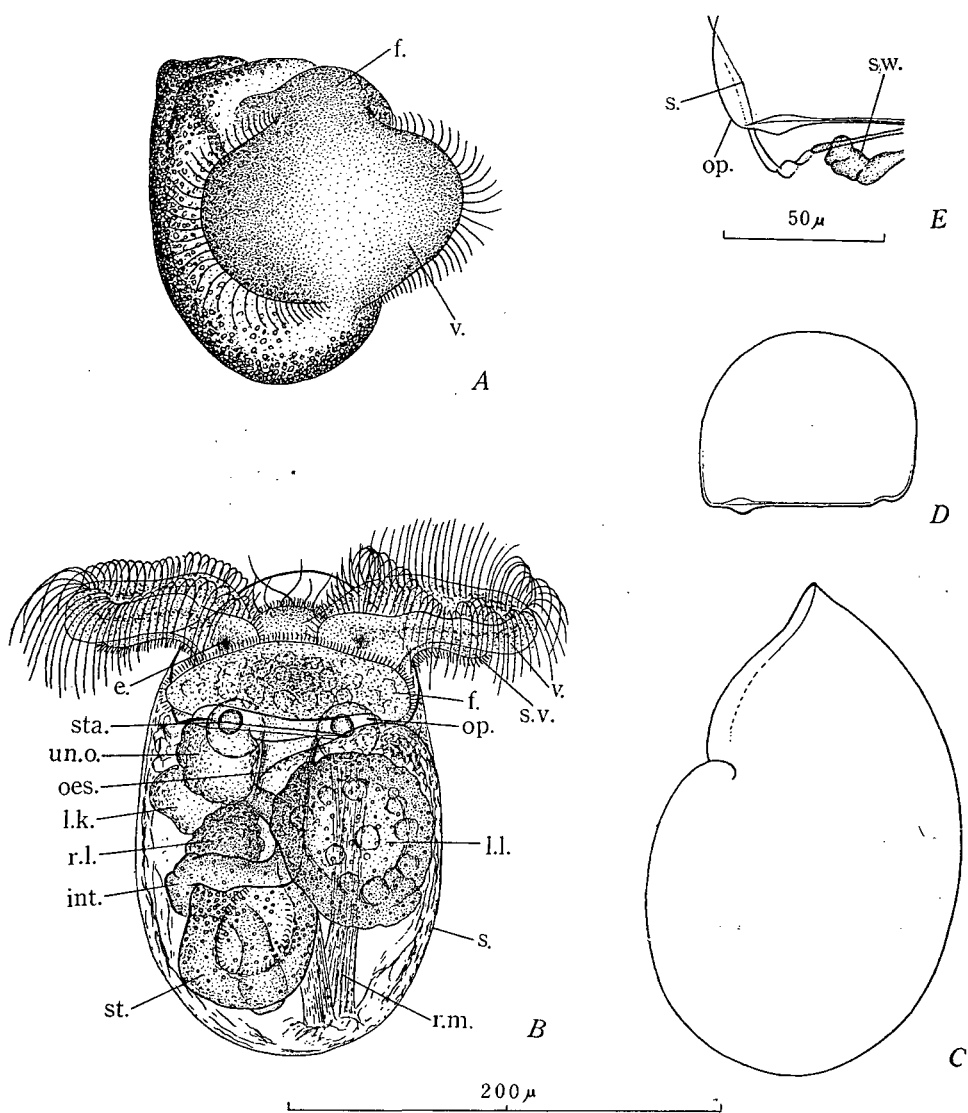


Fig. 9. *Catriona pinnifera* (BABA).

- A. The earliest stage of veliger, from the right latero-ventral side.
- B. Newly hatched veliger, from the ventral side.
- C. Larval shell, from the apex.
- D. Operculum.
- E. Lower portion of the thickening along the inner part of axis. (op.···margin of operculum, s.···margin of shell aperture.)

(For abbreviations see Fig. 2.)

The velum of this species is also rather small, the subvelum is present. The intermediate portion between both vela bears cilia, some of which are much longer than others. There are a pair of black pigmented eyes and that of large statocysts. The foot is densely covered with short cilia and has long sensory cilia along the periphery, but the foot itself does not extend beyond the edge of the operculum; no large cells are included in its tissue. Both mouth and oesophagus are not pigmented; the stomach is rather large as compared with that of *C. ornata* and contains many minute elliptical granules in the wall. There are two liver-lobes, both are colourless, although the smaller right-lobe is seen somewhat darkly. The left-lobe is much larger than that of *C. ornata*. The appearance of intestine is quite the same as that of *C. ornata*. The larval kidney is colourless and transparent. There is an unknown organ (Fig. 9, B, un.o.) just before the larval kidney which is colourless and transparent and probably homologous to the "yellow organ" mentioned in *C. ornata*. The organ does not include any minute granules, and this feature differs evidently from that of the preceding species.

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